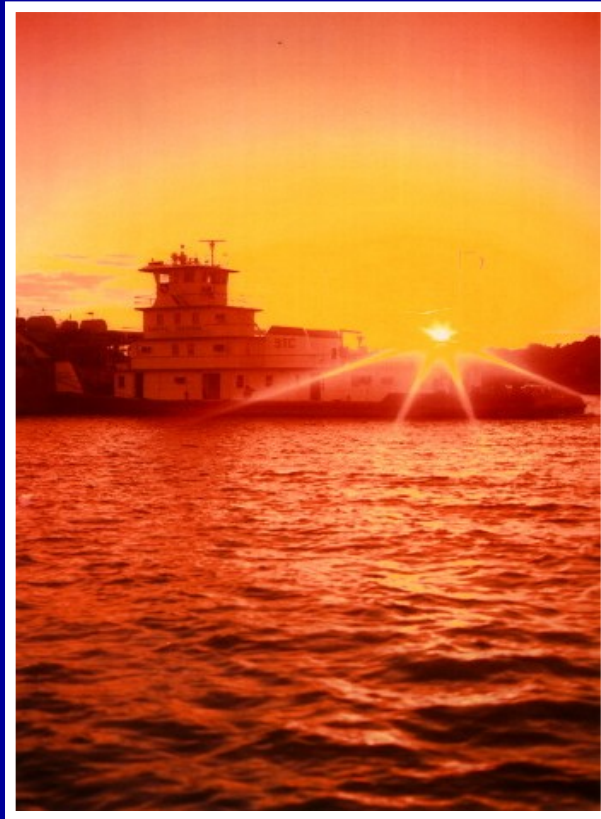


Hydraulic & Hydrologic Considerations In Planning **NAVIGATION STUDIES**



Chuck Shadie
Mississippi Valley Division



Objectives

Provide insight as to the role of the Corps in navigation

Present the Navigation Business Practice

Present H&H role in Navigation Planning Process

Discuss the H&H Interaction with Planning Team



NAVIGATION BUSINESS PRACTICE

Mission Statement:

“To provide safe, reliable, efficient, and environmentally sustainable waterborne transportation systems (channels, harbors, & waterways) for movement of commerce, national security needs and recreation.”*

*Department of the Army Civil Works Program
Strategic Plan FY 2001-06



NAVIGATION BUSINESS PRACTICE

Future Operating Capabilities:

1. To make the existing system work better by Infrastructure Enhancements to support projected 2020 traffic demands ensure a high level of reliability.
2. To provide new system components that will be *INTEGRATED NAVIGATION SYSTEM DESIGN AND MANAGEMENT* for the Navigation 2020 Vision a safe, efficient, effective, reliable, environmentally responsible system.
3. To perform *REGIONAL SEDIMENT MANAGEMENT* to optimize function of the system, reduce costs, and increase benefits.
4. To conduct *DREDGING AND DREDGED MATERIAL MANAGEMENT* to minimize costs and maximize benefits.



Navigation Facts

- Corps helps maintain channel depths at more than 900 deep & shallow draft harbors & ports.
- More than 95% of overseas trade moves in & out of the U.S. by ship.
- There are 25,000 miles of inland, intracoastal & coastal waterways and channels in the U.S.
- Approx. 12,000 miles constitute the commercially active inland & intracoastal waterways maintained by Corps
- Inland & intracoastal waterways serve 38 states directly moving about 630 million tons of cargo valued at \$73 Billion annually.



Shipping Changes

OLD VS. NEW

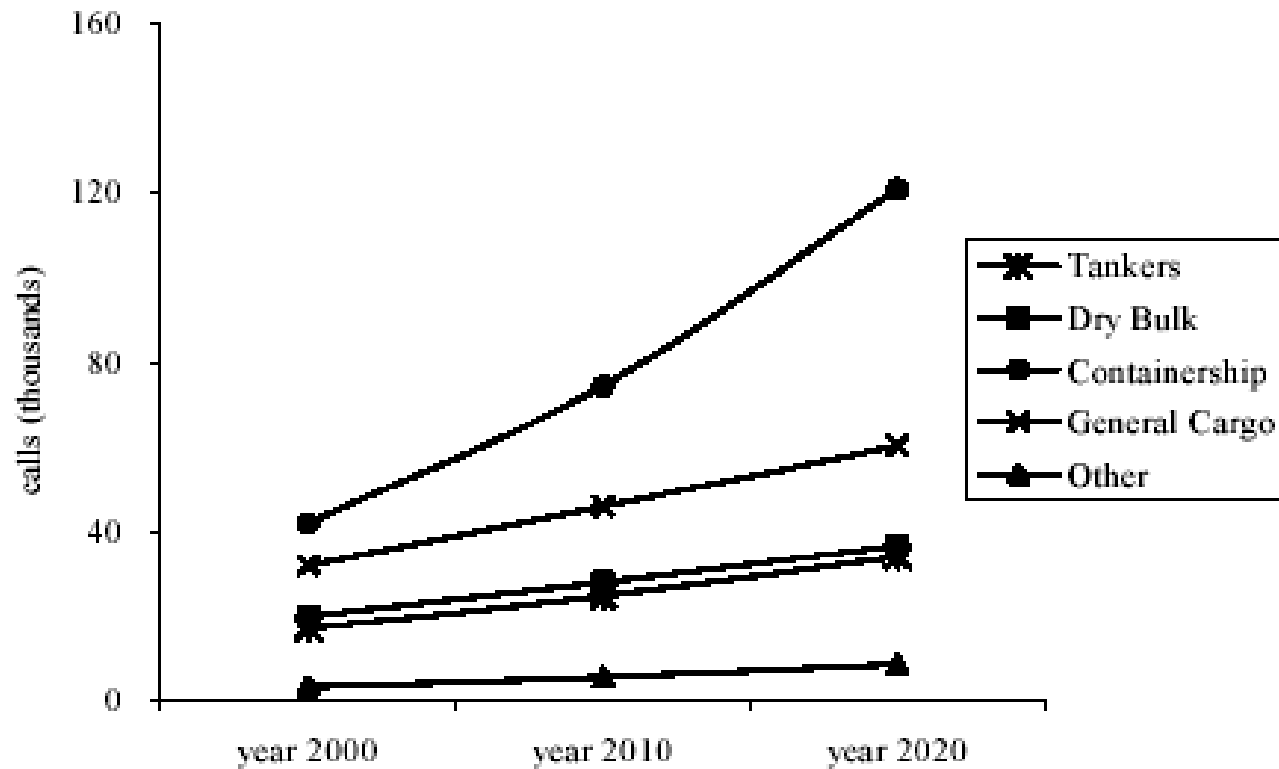
1978
2600 teu

1998
4600 teu



* teu = twenty-ft equivalent units

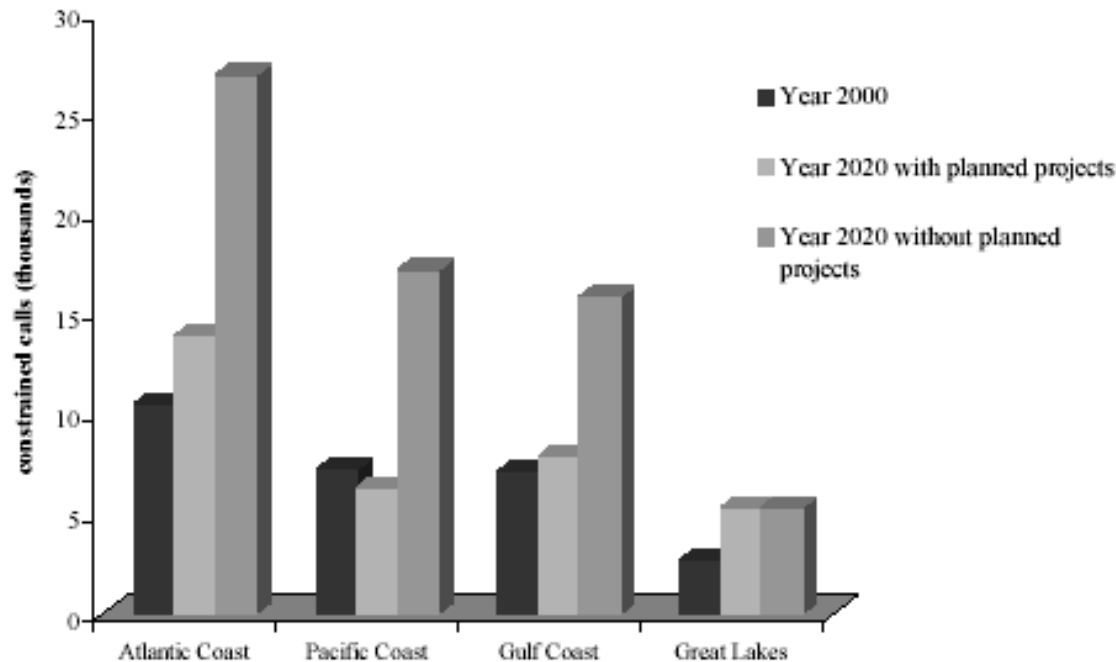
Shipping Forecasts



**Projected Number of Annual Calls to
and from U.S. Ports by Ship Type: Year 2000-2020**

Source: Based on data from the Waterborne Commerce Statistics Center

Shipping Limitations



**Constrained Calls by Coastal Region with
and without Planned Corps Projects: Year 2000 and 2020**

Source: Based on data from the Waterborne Commerce Statistics Center

Constrained Calls - Vessel port calls (primarily containership) which cannot reach the port due to constrained channels (depth or width)

Types of Navigation Projects

Navigation Channels

Deep Draft (>16 ft)

Shallow Draft (<16 ft)

Locks and Dams

(276 chambers at 230 lock sites)

Port Facilities & Turning basins

(Corps involvement in over 500 harbors)

Offshore, Approach, & Harbor Channels

(Includes protective works



Deep Draft Navigation (Over 16 feet)



Shallow Draft Navigation (Under 16 feet)



Lock & Dam Facts

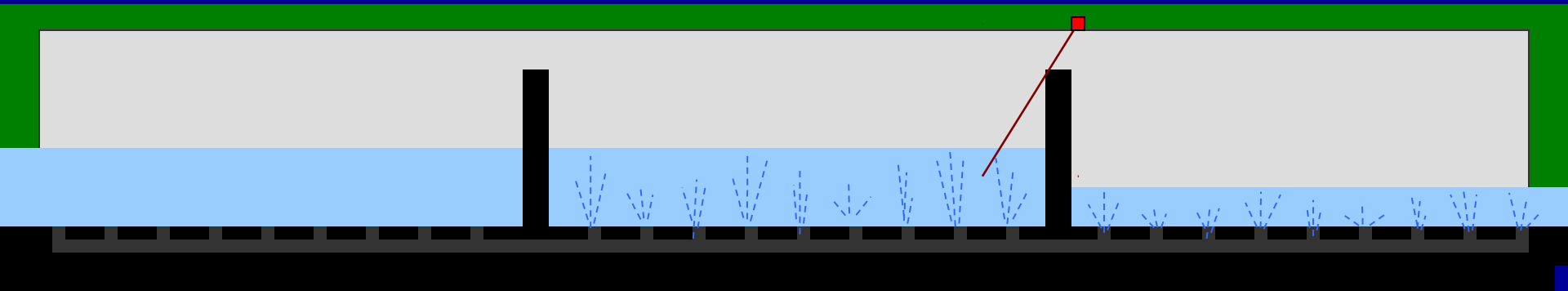
- COE owns/operates 276 lock chambers at 230 sites
- 142 lock chambers, (51% exceed their 50 year design life)
- Total lift of COE locks is 6,466 feet (over 1.2 miles)
- Oldest operating locks in US are KY River Locks 2 (Built in 1839)
- John Day Lock in OR has the highest lift of 110 feet.
- By comparison, the Upper Mississippi River's 29 locks have a combined lift of 404 feet.



John Day Lock and Dam (OR)

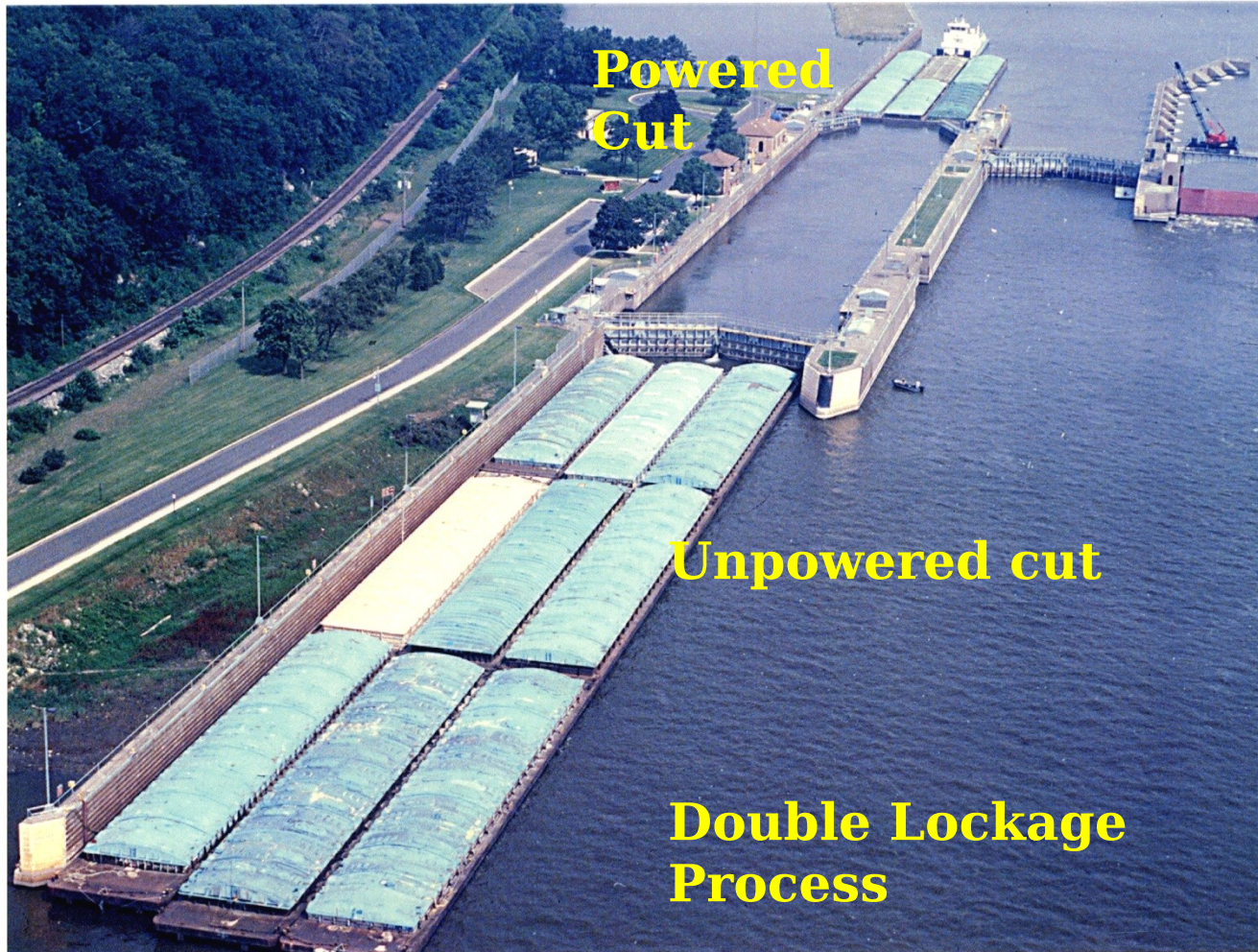


How a Lock Functions



- **Factors affecting a Tow's processing time through**
 - **Approach Channel**
 - **Chamber Size**
 - **Emptying-Filling System**
 - **Exit Channel**
 - **Guide Walls**
 - **Tow Haulage Units**

How a Lock Functions



Aging Lock Inventory

Age (Years)



Dredge McFarland





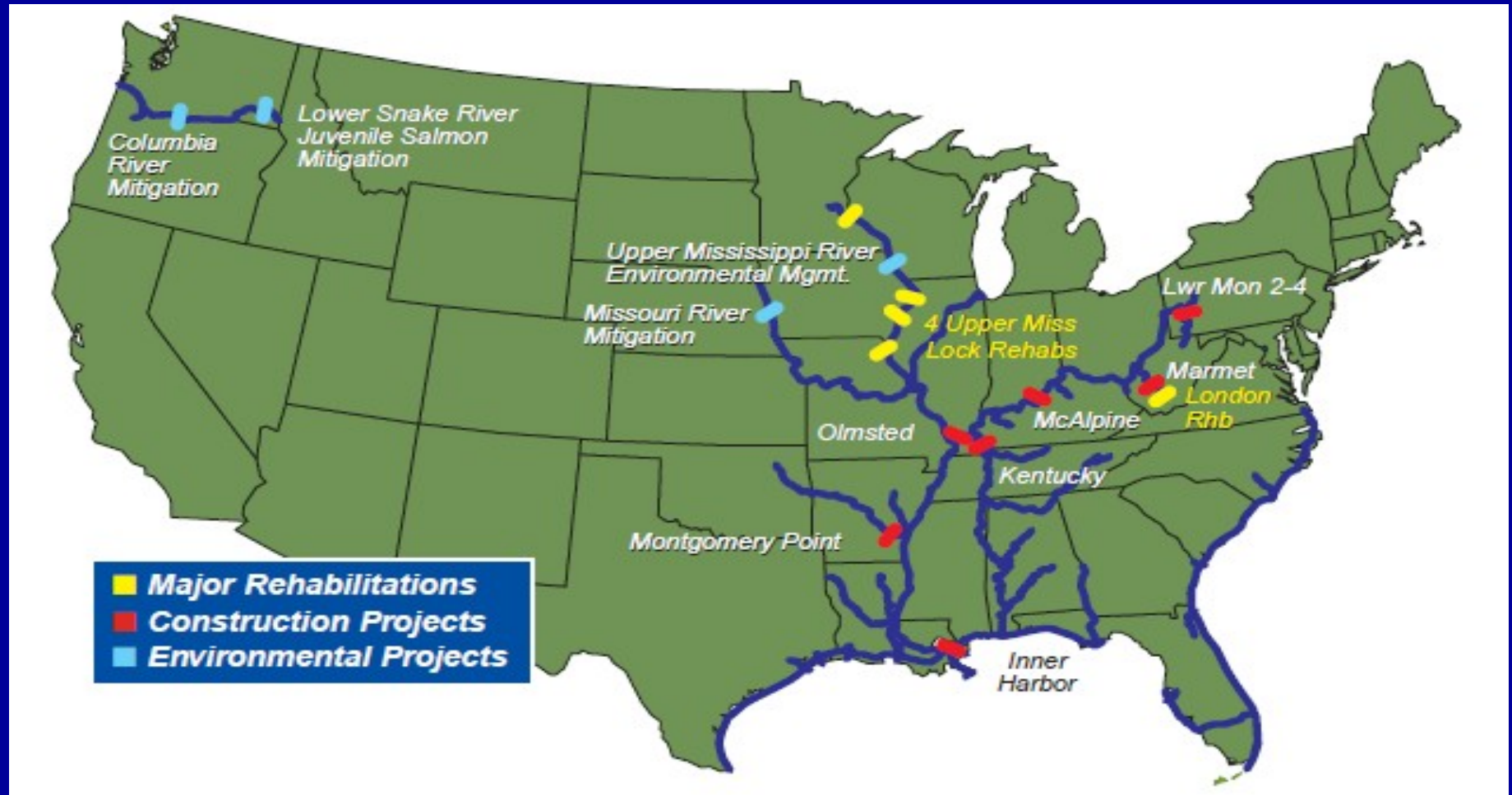
The Inland Navigation System



Inland Waterways Trust Fund *Status*

	FY 2003	FY 2008	FY 2010
Starting Balance	\$387.8 M	\$209.4 M	\$57.8 M
Revenues	\$89.5 M	\$87.6 M	\$73.9 M
Interest	\$9.5 M	\$4.8 M	\$0.13 M
Outlays	\$101.6 M	\$171.0 M	\$73.3 M
Ending Balance	\$391.6 M	\$130.8 M	\$58.5 M

Major Navigation Projects Underway Cost-Shared with Trust Fund



Major Inland Navigation Studies

- Several major studies of inland navigation needs to and beyond 2020

- Ohio River – 600' lock extensions at Greenup and Myers authorized
- Upper Miss / IL Wwy
- GIWW: Bayou Sorrel & Calcasieu
- Chickamauga Lock
- Texas GIWW
- Arkansas River



Ohio River Mainstem Navigation System



RED RIVER, LOUISIANA



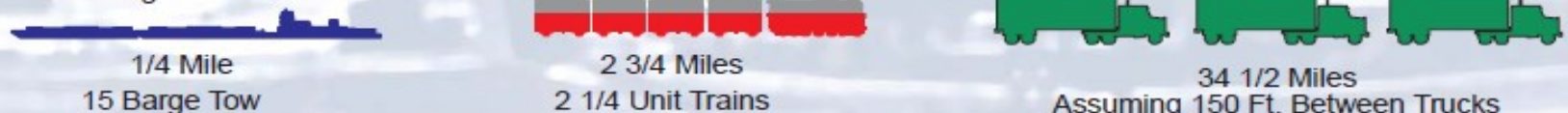
Barge vs Rail or Truck

Alternate Transportation Mode Comparison

				
Barge	15-Barge Tow	Jumbo Hopper Car	100 Car Unit Train	Large Semi
1500 Ton	22,500 Ton	100 Ton	10,000 Ton	26 Ton
52,500 Bushels	767,500 Bushels	3,500 Bushels	350,000 Bushels	910 Bushels
453,000 Gallons	6,804,000 Gallons	30,240 Gallons	3,024,000 Gallons	7,865 Gallons



Equivalent Lengths



Source: Inland Waterway Navigation - Value to the Nation, USACE

Channel Dredging

- 216.5 million cubic yards removed in 2008 at a cost of \$1.012 Billion
- Average cost for maintenance was \$4.20/cy versus \$10.06 for new construction on navigation projects
- In FY 2008, approx 70 private dredging companies were awarded a total of 160 contracts



Dredging

- Basic Dredge Types
- Dredge Material Disposal Alternatives

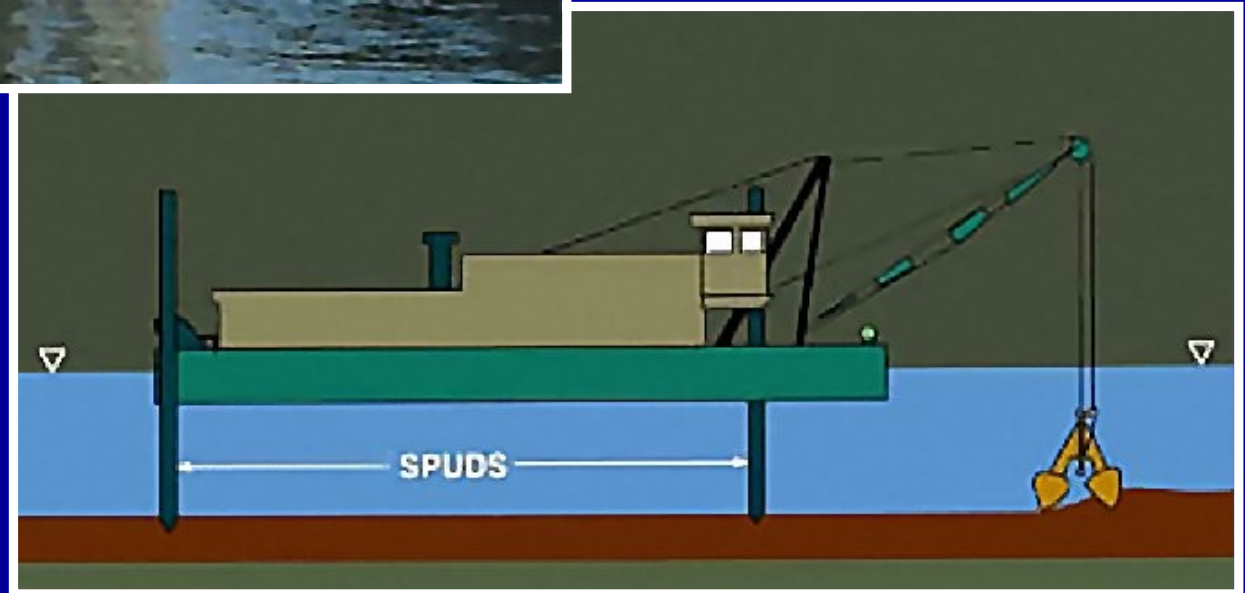
Basic Dredge Types

- Mechanical
 - Clamshell / Bucket
- Hydraulic
 - Hopper
 - Cutterhead
 - Dustpan
 - Pipeline
- Other / Combinations

Mechanical Dredges



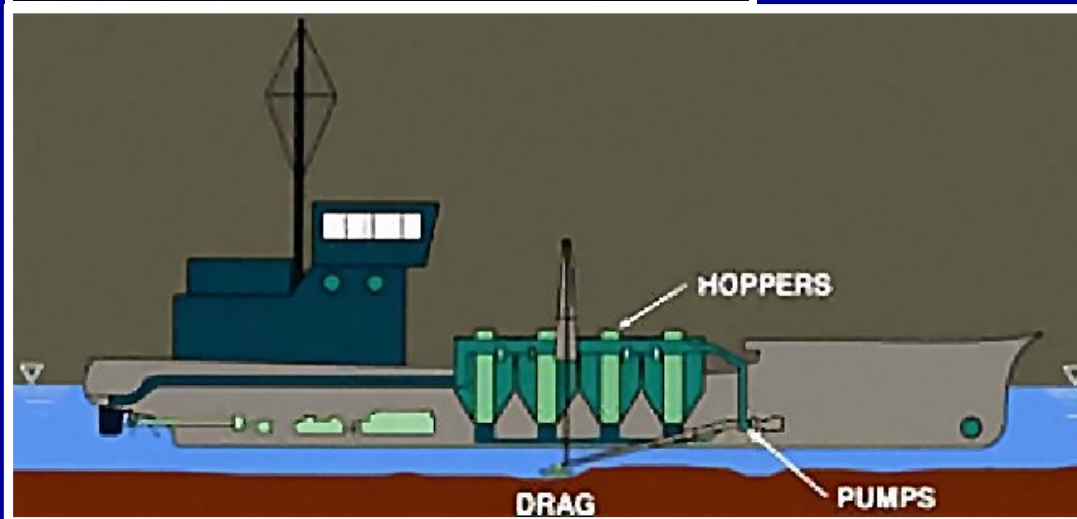
Clamshell/Bucket



Hydraulic Dredges



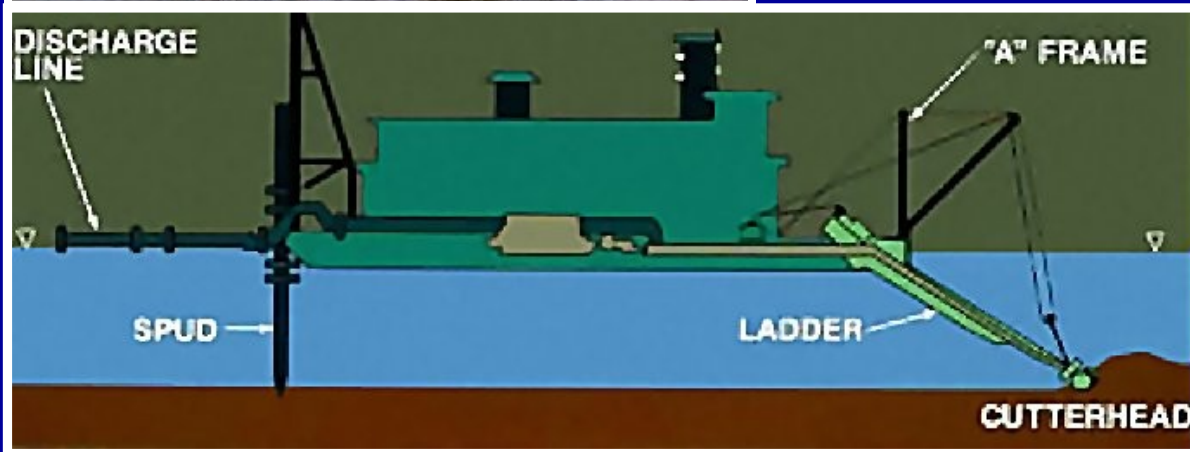
Hopper



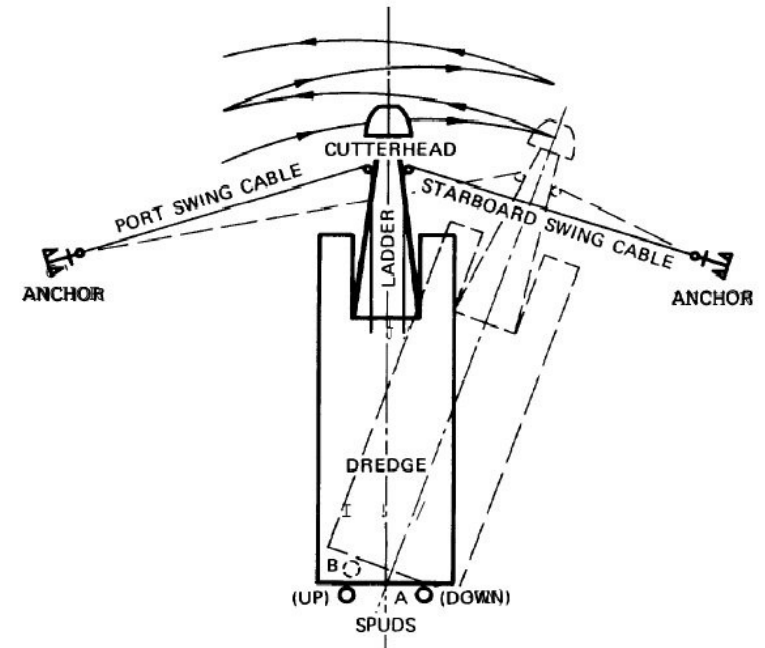
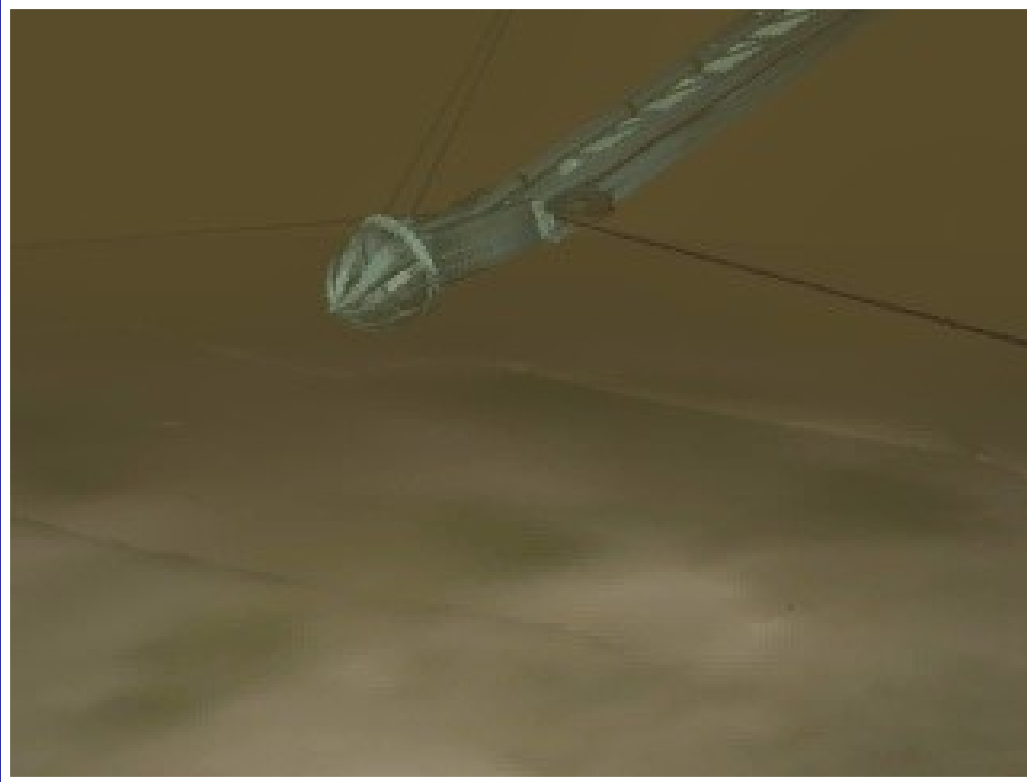
Hydraulic Dredges



Cutterhead



Cutterhead

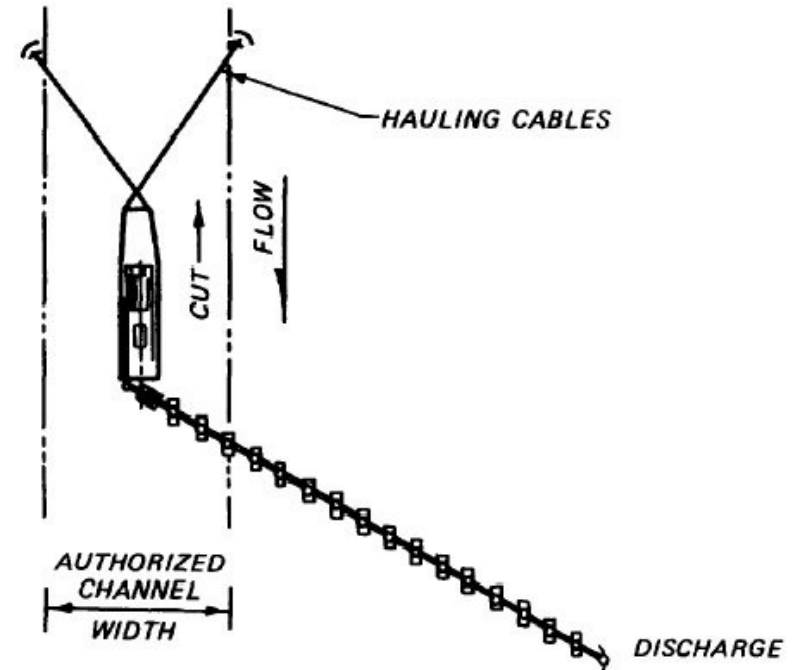
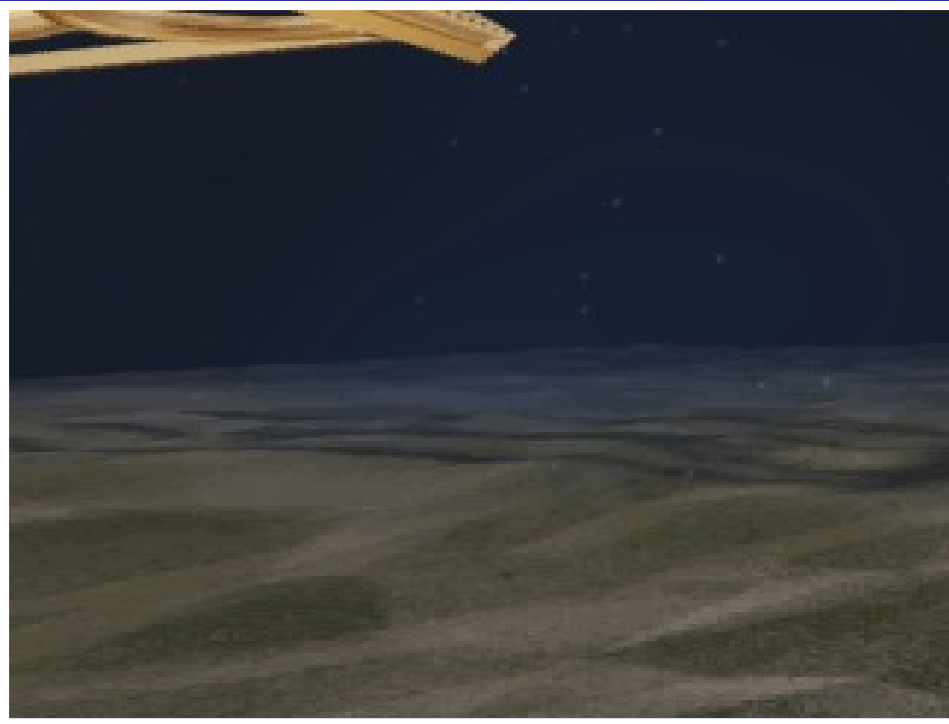


Hydraulic Dredges



Dustpan

Dustpan Dredge



Other Types of Dredges



Dredging

- Basic Dredge Types
- Dredge Material Disposal Alternatives

Dredge Material Disposal Alternatives

- Open Water Placement
 - Within-Bank Placement
- Confined Disposal Areas
- Beneficial Use Applications

Open Water Placement



Within-Bank Placement

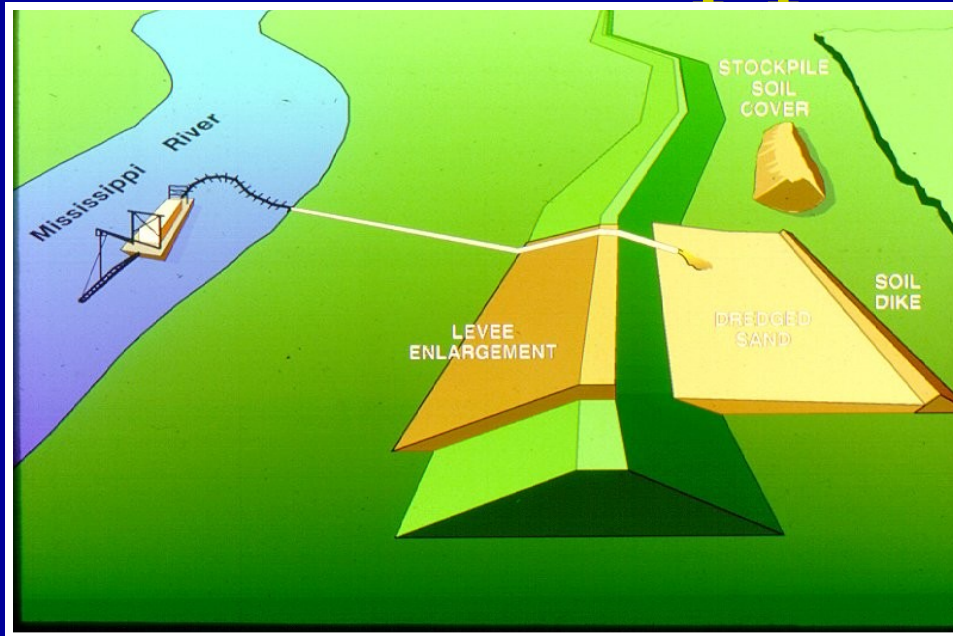


Confined Disposal Areas



Beneficial Use Applications

Mississippi River Levee Enlargement



Beneficial Use Applications

Thin Layer Disposal



Beneficial Use Applications Head of Passes



H&H Interaction with Planning Team

- ~70% -- Structural, Electrical/Mechanical, USACE Labs,
Economics
- ~20% -- Geotechnical, Operations, Cost Engineering
- ~10% -- Construction, specifications, Site Development,
Surveys, Navigation Industry, Cultural Resources, Environmental, Reservoir Regulation



H&H Interaction

- **Navigation Industry**

- How & Why They Navigate A Certain Way
- How They Would Like to Navigate in the Future
- River Experience
- Model Demonstrations
- Safety Concerns
- Closures & Restrictions During Construction

- **Surveys**

- Soundings
- Mapping

- **Economics**

- Transit Times (Thru Channels and/or Locks/Gates)
- Emptying & Filling Systems
- Queing
- Benefits
- Benefit/Cost Ratio



H&H Interaction

•USACE Labs

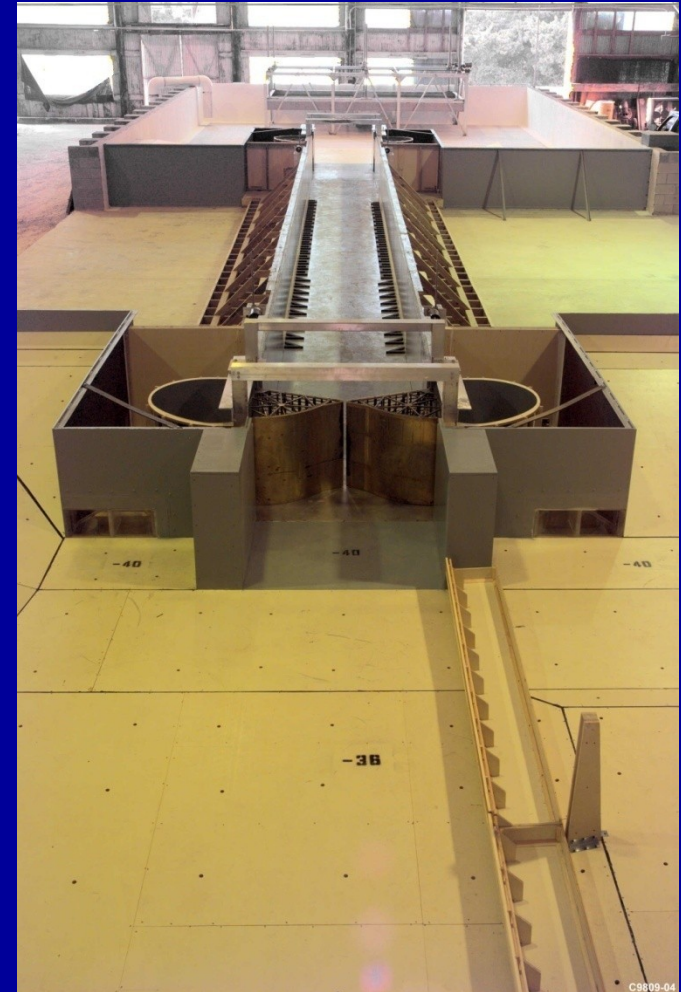
- Physical Models
- Numerical Models
- Hawser Forces
- LOCKSIM
- Energy Dissipation - Inside Lock & Emptying System
- Ice Mitigation - Lock & Approaches
- Modeling Without Project (Baseline)
- Modeling With Project
- Modeling During Construction
- Float-In Construction - Construction Area to Site
- Float-In Construction - Final Positioning



ERDC Ship Simulator



IHNC Physical Model



H&H

• **Geotechnical** Interaction

- Foundations
- Rock Durability
- Riprap Gradation/Filter Material Criteria
- Side Slopes
- Other Types of Protection (Grout Filled Bags, etc.)

• **Structural**

- Wall Thickness & Elevation
- Structural Considerations for Culverts
- Miter & Bulkhead Sill Depth
- Flow Passage under Sill Areas & Past Recesses
- Chamber Floor Elevation
- Anchoring
- Culvert Location & Invert
- Guard Wall Type
- Guard Wall Ports
- Scour Allowance (Foundation Design)



H&H Interaction

- **Electrical & Mechanical**

- Gates
- Valves
- Operating Equipment
- Sluices

- **Cost Engineering**

- Cost of Items
- Cost of Construction Types & Methods
- Comparison of Alternatives
- Value Engineering Studies
- Benefit/Cost Ratios



H&H Interaction

- **Construction**

- How They Will Construct
- Sequence of Construction
- Is it Constructible
- Cofferdam Flooding
- Float-In Construction

- **Operations**

- How They Operate
- Why They Operate a Certain Way
- Arrival Points
- Safety Issues - Vision, Lights, Mooring Bits, Ladders

- **Reservoir Regulation**

- Transit Times (Thru Channels and/or Locks/Gates)
- Emptying & Filling Systems
- Queing
- Benefits
- Benefit/Cost Ratio

Lock wall, Lower Mon 3



*Lock wall
deterioration*

Chickamauga

Engineering Regulations pertaining to H&H Design for Navigation

- ER 1110-2-1404 Hydraulic Design of Deep-Draft Navigation
- ER 1110-2-1407 Hydraulic Design for Coastal Shore Protection Projects
- ER 1110-2-1458 Hydraulic Design of Shallow Draft Navigation Projects
- ER 1130-2-520 Navigation and Dredging Operations and Maintenance Policies
- ER 1165-2-27 Establishment of Wetlands Areas in Connection with



Engineering Manuals pertaining to H&H Design for Navigation

- EM 1110-2-1604 Hydraulic Design of Navigation Locks
- EM 1110-2-1605 Hydraulic Design of Navigation Dams
- EM 1110-2-1607 Tidal Hydraulics
- EM 1110-2-1611 Layout and Design of Shallow-Draft Waterways
- EM 1110-2-1613 Hydraulic Design of Deep-Draft Navigation Projects
- EM 1110-2-2904 Design of Breakwaters and Jetties



Objectives

Provide insight as to the role of the Corps in navigation

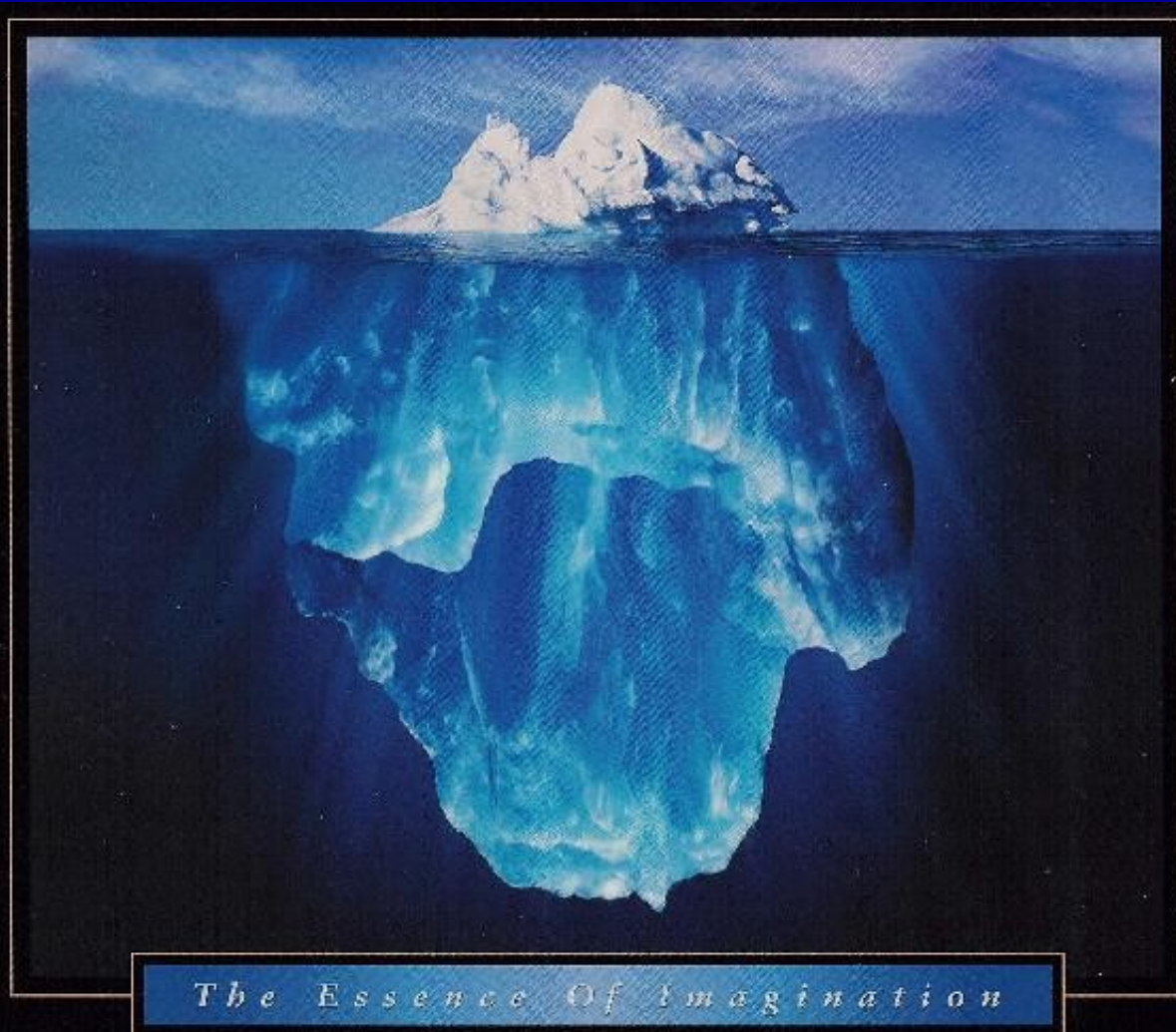
Present the Navigation Business Practice

Present H&H role in Navigation Planning Process

Discuss the H&H Interaction with Planning Team



We need creative engineering in the Corps.



*"What we can easily see is only a small percentage of what is possible.
Imagination is having the vision to see what is just below the surface;
to picture that which is essential, but invisible to the eye."*

